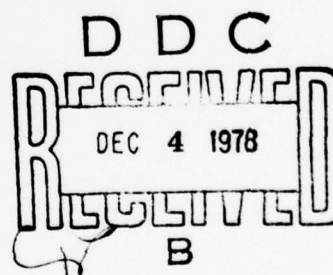Research Report 1201

(12) LEVEL II

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EVALUATION OF AN ACHIEVEMENT TEST FOR MAP INTERPRETATION IN NAP-OF-THE-EARTH FLIGHT

William R. Bickley

ARI FIELD UNIT AT FORT RUCKER, ALABAMA

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Rotary wing (RW) nap-of-the-earth (NOE) flight requires two major skills: superior aircraft control and specialized map interpretation and pilotage. U.S. Army training in the latter is to be accomplished via the Map Interpretation and Terrain Analysis Course (MITAC). This course of instruction presently lacks an instrument for measuring comprehension of the concepts and principles taught in it. In evaluating a potential achievement test, 115 items were administered to 182 initial entry RW students, and a subset of 49

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highly reliable items was identified. Students' scores on this subset were validated against their performance 6 weeks subsequent as NOE navigators. Test reliability and validity are discussed in detail.

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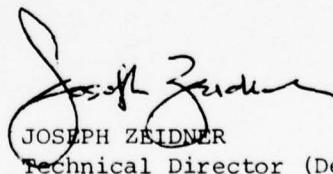
William R. Bickley

ARI FIELD UNIT AT FORT RUCKER, ALABAMA

The Organizations and Systems Research Laboratory of the Army Research Institute for the Behavioral and Social Sciences (ARI) has as its goal the optimal utilization of the various U.S. Army combat systems. ARI approaches this goal via two general avenues: by training or selecting soldiers to interact with and operate existing systems, or by participating in the development of new systems to assure their being designed with the human operator in mind.

The work reported here involves a facet of training aimed at an existing system. One of the results of an Army-wide 1973 conference on aircrew performance in Army aviation was a tasking of ARI to address navigation training requirements for the very low level or nap-of-the-earth (NOE) flight environment. In its shift of emphasis to NOE flight, the Army has discovered that present-day rotary wing aviators, although well able to maneuver at NOE altitude, find it difficult to navigate and maintain orientation accurately for any period of time without special training.

To improve pilot navigation performance in NOE flight, the ARI Field Unit at Fort Rucker, Ala., has developed an academic training program for NOE map interpretation for the Director of Training, U.S. Army Aviation Center, Fort Rucker. This development was conducted as a part of Army Program 2Q263743A772A1, Aircrew Performance Enhancement in the Tactical Environment. The course of instruction approaches map interpretation from the NOE point of view, emphasizing the relatively small NOE field of view and the lack of correlation between map features and real-world features at low altitude.

This report presents the evaluation of an achievement test designed to assess student aviators' comprehension of NOE map interpretation concepts. The test instrument is to be integrated and fielded with the NOE Map Interpretation and Terrain Analysis Course (MITAC).

JOSEPH ZEIDNER
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EVALUATION OF AN ACHIEVEMENT TEST FOR MAP INTERPRETATION IN NAP-OF-THE-EARTH FLIGHT

BRIEF

Requirement:

The requirement was to develop an achievement test to measure comprehension of the concepts and principles taught in the Army's Map Interpretation and Terrain Analysis Course (MITAC) for nap-of-the-earth (NOE) flight.

Procedure:

Initial-entry rotary wing (IERW) aviator graduates of MITAC at the U.S. Army Aviation Center, Fort Rucker, were administered a pool of test items designed to assess MITAC comprehension. These same students' performance as NOE navigators was evaluated at a later point in the IERW curriculum, and the achievement test results were validated against the navigation performance results.

Findings:

From the initial item pool, 49 items were identified with significant item-to-total-score correlations and were statistically determined to address a common core of map interpretation knowledge. This 49-item test was also found to marginally correlate with later performance as an NOE navigator.

Utilization of Findings:

The 49-item achievement test will be fielded with the MITAC package as an instrument for assessing comprehension of NOE map interpretation principles.

EVALUATION OF AN ACHIEVEMENT TEST FOR MAP INTERPRETATION IN NAP-OF-THE-
EARTH FLIGHT

CONTENTS

EVALUATION OF AN ACHIEVEMENT TEST FOR MAP INTERPRETATION IN NAP-OF-THE-EARTH FLIGHT

BACKGROUND

As the U.S. Army has increased its utilization of rotary wing (RW) airborne systems platforms and logistical support, potential threat forces' utilization of antiair (AA) systems has increased proportionately. To evade detection by threat AA sensors and engagement by threat AA weaponry, U.S. Army RW tactics on the modern mid- to high-intensity battlefield will be couched in the "terrain" flight envelope, that is, RW aircraft will operate so that they can take advantage of the concealment or "masking" from threat sensors and weapons systems afforded by the terrain itself.

Terrain flight is arbitrarily divided into three modes: low-level, contour-following, and nap-of-the-earth (NOE). Of these three, NOE involves flight closest to the ground. In the NOE mode, the RW aviator flies as close to the earth's surface as possible, flying around (instead of over) obstacles and vegetation if at all feasible. Visual pilotage is utilized both in controlling and maneuvering the aircraft and in maintaining geographical orientation.

The flying skills requisite for controlling and maneuvering the aircraft at NOE altitudes are fairly easily acquired; however, maintaining geographical orientation along a route of any length is a skill that requires specialized training. The Army is now implementing a training system for maintaining NOE orientation called the Map Interpretation and Terrain Analysis Course (MITAC). In essence, the course teaches the aviator to interpret standard 1:50,000 topographic maps from the NOE point of view. Interpretation in this instance refers not only to the learning of cartographic symbology but also to the comprehension of the much less than perfect correlation between real-world features and those portrayed on the map.

OBJECTIVE

Prior to the aviator's progressing from MITAC to relatively expensive real-time training in NOE navigation in the aircraft, some assessment of his comprehension of key principles of map interpretation should be made. One of the more efficient and objective methods of accomplishing this assessment consists of administering a course-exit achievement test to the student aviators and using scores obtained on the test as a criterion for progressing to aircraft training. This report describes in detail the development and evaluation of such a test.

1

PROCEDURES AND RESULTS

A sizable pool of potential test questions was administered
to IERW student aviator classes at the U.S. Army Aviation Center
(USAAVNC), Fort Rucker, after they had completed the center's MITAC
academic course of instruction. A set of 49 highly interrelated and
reliable test items was identified, and students' scores on this set
were subsequently validated against their actual performance as NOE
navigators. Figure 1 outlines this sequence of events.

DISCUSSION

The achievement test developed in the course of this study is a
statistically reliable product with marginal use in predicting students'
initial performance as NOE navigators. Doubtless, as aviators gain more
experience as NOE navigators, the test's predictive ability becomes less
precise.

The test, along with instructions, scoring sheets, etc., will be
integrated and fielded with the MITAC package as a relatively effective
means of monitoring students' academic knowledge of map interpretation
principles prior to their progressing to NOE training in the aircraft.
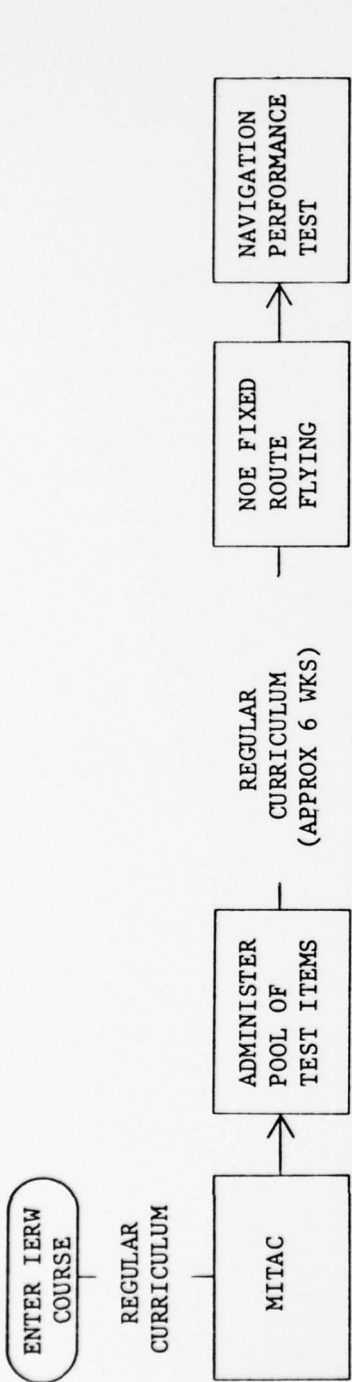
a. Sequence of events for initial test evaluation.
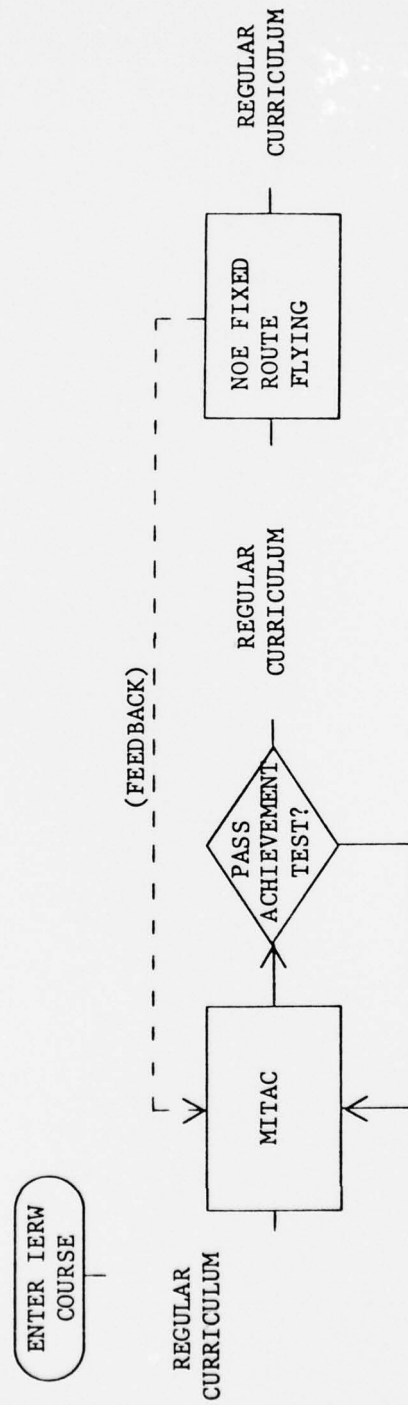
b. Possible integration of MITAC achievement test with present IERW curriculum.

Figure 1. Initial entry rotary wing course sequence of test evaluation and MITAC integration.

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TECHNICAL SUPPLEMENT

The conventional evaluation of any test instrument is directed toward two general areas: assessment of the test items themselves, for internal consistency, and validation of test scores against some external criterion. The following summary is organized around these two areas: reliability and validity.

Procedures

Test Items. One component supplied with the MITAC package is an instructional pamphlet entitled "Map Interpretation in NOE Flight," which explains the fundamental principles of NOE mapreading. The MITAC contractor has also supplied a pool of 115 multiple-choice and true-false potential test items based on material presented in the pamphlet. The pool has a subjectively high internal face validity in that all items can be answered by referring to facts or concepts contained in the pamphlet. Across all items, the position of the correct response is systematically varied to appear equally often in all response positions. Sample items (which were not included in the final form of the test) appear in Appendix A.

Subjects. IERW students at USAAVNC, Fort Rucker, are the ultimate target population for MITAC once all those aviators now in the field have been exposed to the course. IERW students range in educational background from high school to college graduate, in age from 18 to 26, in rank from Warrant Officer Candidate to First Lieutenant, and in military service from 0 to 8 years; the students include male and female Army and Air Force personnel. Allied and NATO students also are included in regular IERW classes; they were specifically excluded from the sample. In all, 245 IERW students were administered the original pool of items.

Achievement Test Administration. The pool of items was presented to students by the Terrain Flight Operations instructors as a normal point in the IERW curriculum immediately after instruction in map interpretation was completed. Students were allowed one class period (50 minutes) to complete the test. The test was not speeded; students who required additional time for completion were allowed it as was feasible. Following administration of the test, students were debriefed by ARI personnel, and comments were solicited for any individual items.

Performance Test Administration. Approximately 6 weeks (dependent on weather and class size) subsequent to completion of the academic map interpretation course, IERW students are in their ninth and final hour of flying standard, fixed NOE routes. The Fort Rucker training complex

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presently has 37 such training routes, all of varying lengths and difficulties. Each student receives a total of 9 hours of training as pilot and as navigator on these routes before progressing to less standardized corridor flight. Insofar as possible, no student flies any one route twice, either as pilot or as navigator. Each route has four preplotted points that are to be identified by the student navigator: the starting point, two phase lines (checkpoints), and the release point.

Instructor pilots (IP's) were tasked with collecting data from each student's ninth hour of training as an NOE navigator. Data elements recorded included:

1. Route identification,

2. Start point time,

3. Release point time,

4. Meters (to nearest 100 meters) of error to right/left of projected track in identifying each point, and

5. Meters of error ahead/behind track in identifying each point.

The first three elements, when combined with route length, were used to obtain average speed for a route, and the last two elements were used to calculate actual distance between assumed position and preplotted point.

Results

Reliability. Item analysis of 182 students' responses to the full 115-item pool identified 49 items with statistically significant item-to-total-test-score correlations (r's $\geq$ .145, p $\leq$ .025). (These correlations, of course, do not include the item being correlated in computing total score.) Further analysis of this smaller set of items yielded an alpha reliability coefficient[1] of .80 and a mean of 32.6 items correct, with a standard deviation of 6.4 items.

Table 1 shows for each item its difficulty level and item-to-total-score correlation. Note that items 36 and 46, even though they are relatively difficult, do not have low item-to-total-test-score correlations.

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[1]Cronbach, L. J. Coefficient Alpha and the Internal Structure of Tests. Psychometrika, 1951, 16, 297-334.

Table 1

Individual Item Descriptions

Number	Difficulty[a]	r[b]		Number	Difficulty	r
1	(filler)			26	.611	.215
2	.815	.215		27	.957	.245
3	.953	.181		28	.820	.211
4	.720	.398		29	.659	.360
5	.592	.176		30	.488	.147
6	.602	.300		31	.682	.281
7	.455	.243		32	.839	.413
8	.607	.291		33	.341	.261
9	.303	.182		34	.957	.179
10	.341	.378		35	.374	.230
11	.787	.154		36	.071	.211
12	.545	.286		37	.573	.339
13	.758	.240		38	.896	.153
14	.801	.336		39	.801	.229
15	.550	.281		40	.502	.149
16	.782	.243		41	.787	.195
17	.782	.182		42	.900	.216
18	.450	.374		43	.630	.357
19	.654	.278		44	.773	.248
20	.810	.435		45	.758	.148
21	.635	.222		46	.171	.222
22	.844	.356		47	.739	.170
23	.763	.298		48	.450	.233
24	.825	.254		49	.464	.147
25	.384	.298		50	.825	.221

[a] Difficulty: level of difficulty (or probability of correct response).

[b] r: item-to-total-score correlation.

Content Validity. The instructional pamphlet for NOE training is divided into five major sections. The number of test items in the original set and in the 49-item test that is pertinent to each section is shown in Table 2. Aviation Center MITAC academic instructors, after an informal perusal of the 49 items, agreed that all 49 are pertinent to NOE map interpretation and cover facts and concepts presented in the MITAC curriculum.

Table 2

Test Items Relevant to Curriculum Topics

Topic	Original pool	Final test
1. General considerations	11	1
2. Characteristics of topographic maps	15	6
3. Interpretation of terrain relief	19	7
4. Interpretation of vegetation	11	6
5. Interpretation of hydrography	16	6
6. Interpretation of manmade features	43	23

External Validity. The NOE performance test was conducted to provide an objective measure against which the achievement test scores might be validated. Navigation of an NOE route was conceptualized as a four-item test, with each of the four points a navigator was to identify being considered a test item. Each item's score was the approximate direct distance in meters the student navigator was from the actual point when the student reported himself as being at the point. These scores ranged from 0 to 1,411 meters. The composite score on the test was the mean of these four errors; this composite ranged from 0 to 1,215 meters, with an average of 391 meters and a standard deviation of 432 meters. The scores' alpha reliability was .21.

Additionally, these scores were transformed (as described in Appendix B) to take into account not only error magnitude but also average speed along the route. The average transformed scores, which can be conceptualized as probability of NOE mission success, had a mean of .91 and standard deviation of .37. The transformed score alpha reliability was found to be .25.

The coefficient of validity for the achievement test and NOE performance was -.098 ($p \leq$ .15) for navigation raw scores and .100 ($p \leq$ .15) for transformed navigation scores. The negative correlation for raw scores was expected because better navigation performance yields a lower raw score), but neither correlation is significant. Corrected for attenuation, these coefficients are -.191 and .224, respectively.

Discussion

Reliability. As mentioned earlier, one indicator of the suitability of a test of this sort is the degree to which all its items appear to measure a common corpus of knowledge. If all items do address the same general topic, responses to them should be highly intercorrelated--indicating a high degree of internal consistency. In the case of this test, consistency is indicated by the relatively high observed alpha coefficient of .80. This figure, which is based on interitem correlations, may be interpreted as the average of all possible split-half correlation coefficients or, alternatively, as the overall proportion of the test that addresses some common body of knowledge (Cronbach, 1951).

Note that alpha does not identify that body of knowledge; it merely indicates that the items in general all pertain to some common underlying factor(s). The assumption that the unobservable body of knowledge is indeed comprehension of NOE navigation principles is addressed by a consideration of the test's validity.

Validity. A test's validity in essence reveals how relevant the test is to the construct that it purports to measure. In the case of this test, there is a high fact validity. This is inferred from the individual items' contents: each item refers specifically to some point presented in both the NOE navigation instructional pamphlet and the classroom lectures.

Predictive validity is entirely a different matter. If the test truly measures NOE navigation skills, then those students who score high on the test should also excel in NOE navigation performance. However, the relatively low correlation between test scores and navigation performance indicates that this is not necessarily the case. In fact, knowledge of a student's achievement test score does not appreciably affect the precision with which one can predict how well the student will navigate after 9 hours of NOE training.

Thus the question remains to be answered: If the test actually taps those cognitive skills requisite for NOE navigation, why is there so little relationship between test scores and navigation scores? One major reason for the lack of relationship is the relatively low reliability of the navigation test. Taking into consideration that correlation between two test instruments is bounded by their individual reliabilities,[2] it can be shown that the observed correlation between these two tests has a theoretical upper bound of less than .45.

In the case of the navigation test, reliability may be conceptualized as a rough indication that students generally do perform consistently in identifying checkpoints along a route. (Consistency, in this context, is used in the sense of a student's missing each checkpoint by approximately the same distance.) But instead of being consistent, students' performances varied greatly along each route; the average interitem correlation was only .08 for all four checkpoints.

Assuming the IP's were consistent in scoring individual students, the most likely reason for the low intercorrelations among checkpoints is the checkpoints' heterogeneity. The first checkpoint on one route might be in an open field, whereas the first checkpoint on another route might be a road intersection. Very likely these checkpoints differ in difficulty to the extent that the test item variances greatly exceed their covariances.

Another possible cause for the low achievement-navigation test correlation lies in the events intervening between the two tests. As shown in Figure 1, approximately 6 weeks of RW-related training occurred between tests. Additionally, the navigation test was administered during the last of 9 hours of actual navigation training. Thus there was ample opportunity for principles learned during the academic phase to be forgotten and other practical principles to be learned during actual navigation training. Either possibility would tend to "blur" the relationship between the two tests.

This reasoning, of course, gives rise to a third possibility: The principles learned in the academic phase may be nonapplicable to the training routes used at Fort Rucker. But the previous finding[3]--that students trained with MITAC make one-third the errors and fly roughly twice as fast as conventionally trained students--tends to discount this possibility. However, the possibility does remain that the achievement test addresses portions of MITAC that are only incidentally related to navigation performance.

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[2] Novick, M. R. The Axioms and Principal Results of Classical Test Theory. Journal of Mathematical Psychology, 1966, 3, 1-18.

[3] Holman, G. L. An Evaluation of a Map Interpretation and Terrain Analysis Course and Nap-of-the-Earth Navigation. ARI Research Report 1198, August 1978.

From all the foregoing, it can be concluded that the achievement
test is a statistically (internally) sound instrument for measuring
comprehension of the academic portion of MITAC. Its validity as a pre-
dictive instrument remains unclear, primarily because there is no readily
available statistically reliable criterion by which to assess its valid-
ity. A methodology for NOE navigation performance assessment is pres-
ently under development and will be used in any follow-on studies of the
achievement test.

APPENDIX A

ACHIEVEMENT TEST SAMPLE ITEMS

1. The most important effect of the scale factor is that the cartographer must

   a. generalize the shape of linear features.
   b. make a selection of features to be portrayed.
   c. displace features that lie adjacent to each other.

2. You can confidently expect that the highest terrain elevation in the area covered by the map sheet will be identified with a spot elevation numeral.

   T = true
   F = false

3. To use the "relative" method of identifying terrain features, you would

   a. compare terrain height with aircraft altitude.
   b. observe the differences between relief features.
   c. compare terrain orientation with aircraft heading.

4. Most roads are more visible than most railroads.

   T = true
   F = false

5. The selection of features for portrayal depends most strongly on

   a. the type of region being portrayed.
   b. the scale and purpose of the map.
   c. the judgment of the individual cartographer.

6. Because of their simple and bold portrayal on the map, cultural features are easier to interpret reliably than natural features.

   T = true
   F = false

7. As a result of the feature selection process, the distribution of features portrayed on the map is usually more variable than the distribution of features in the real world.

   T = true
   F = false

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8. A cartographer would be most likely to exaggerate scale to show a

   a. sharp bend in a creek.
   b. small cove along a lakeshore.
   c. switchback on a mountain road.

9. Cartographers are given very rigid rules for selecting hydrographic features for portrayal, and have little freedom of choice in deciding which ponds and streams to include on the map.

   T = true
   F = false

10. The smaller the map scale, the more the cartographer must generalize the shape of portrayed features.

    T = true
    F = false

11. Narrow strips of vegetation are normally portrayed only if they are at least 60 meters in width.

    T = true
    F = false

12. Which provides the most important information in interpreting contour lines?

    a. The shape of the lines.
    b. The spacing between adjacent contour lines.
    c. Whether or not a line closes back on itself.

APPENDIX B

APPROXIMATION OF THE JOINT EFFECTS OF SPEED AND DISTANCE
IN JUDGING SEVERITY OF NOE NAVIGATION ERRORS

In deriving a composite dependent measure for NOE navigation per-
formance, two performance variables are assumed to be of prime impor-
tance, if performance is defined in terms of mission success. These two
variables are speed and distance off track. The NOE mission is to be
completed expeditiously and accurately, but speed and accuracy possibly
interact. It should be evident that missing a checkpoint by 100 m at
20 kt is qualitatively different from missing a checkpoint by 100 m
while flying at 80 kt. The study presented here was conducted to gain
some insight on the joint effects of airspeed and deviation from track.

Method

Subjects. Twenty-two NOE-proficient RW aviators participated in
the study. All these subjects were NOE IP's attached to the Advanced
Division of the Department of Undergraduate Flight Training, USAAVNC,
Fort Rucker.

Procedure. The task presented subjects was that of evaluating
student navigators' performances in missing some average checkpoint by
a given distance while traveling at a given speed. The subjects esti-
mated the hypothetical navigators' probability of mission success after
the navigators missed a checkpoint by 150 to 650 m (in increments of
100 m) while flying at 25 to 55 kt (in increments of 10 kt).

The 24 combinations of speed and distance were randomized and pre-
sented one at a time, verbally, to the subjects.

Results

The data were analyzed using a two-way, (6 x 4) within-subjects
analysis of variance. The results of this analysis in Table B-1 show
very strong effects of speed and distance, but no significant inter-
action between them.

The absence of an interaction suggested a regression analysis of
the data, using speed and distance to predict mission success. This
analysis yielded the prediction equation

Mission success = -.43 (distance) - .12 (speed) + 112.07.

The obtained coefficient of determination (R^2) was .89 when corrected
for shrinkage.

Table B-1

Speed and Distance Analysis of Variance Summary

Source	SS	df	MS	F
Between S's	82,938	21	3,949	
Distance	215,393	5	43,079	184. *
Speed	12,075	3	4,025	17.2*
Distance x speed	1,912	15	127	.54
Error	112,861	483	234	

*$p \leq .01$

Discussion

The data indicate that the joint consideration of speed and distance in this experimental context can be considered as two independent processes since the two do not significantly interact. Furthermore, the linear components of speed and distance, when used to predict mission success, account for approximately 90% of the variance.

The regression equation above can thus confidently be used to transform students' raw scores into a measure of mission success.

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2 HQUSACDEC, Ft Ord, ATTN: Library
1 HQUSACDEC, Ft Ord, ATTN: ATEC-EX-E-Hum Factors
2 USAEEC, Ft Benjamin Harrison, ATTN: Library
1 USAPACDC, Ft Benjamin Harrison, ATTN: ATCP-HR
1 USA Comm-Elect Sch, Ft Monmouth, ATTN: ATSN-EA
1 USAEC, Ft Monmouth, ATTN: AMSEL-CT-HDP
1 USAEC, Ft Monmouth, ATTN: AMSEL-PA-P
1 USAEC, Ft Monmouth, ATTN: AMSEL-SI-CB
1 USAEC, Ft Monmouth, ATTN: C, Facl Dev Br
1 USA Materials Sys Anal Agcy, Aberdeen, ATTN: AMXSY-P
1 Edgewood Arsenal, Aberdeen, ATTN: SAREA-BL-H
1 USA Ord Ctr & Sch, Aberdeen, ATTN: ATSL-TEM-C
2 USA Hum Engr Lab, Aberdeen, ATTN: Library/Dir
1 USA Combat Arms Tng Bd, Ft Benning, ATTN: Ad Supervisor
1 USA Infantry Hum Rsch Unit, Ft Benning, ATTN: Chief
1 USA Infantry Bd, Ft Benning, ATTN: STEBC-TE-T
1 USASMA, Ft Bliss, ATTN: ATSS-LRC
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA-CTD-ME
1 USA Air Def Sch, Ft Bliss, ATTN: Tech Lib
1 USA Air Def Bd, Ft Bliss, ATTN: FILES
1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: ATSW-SE-L
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: DepCdr
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: CCS
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCASA
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACO-E
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-CI
1 USAECOM, Night Vision Lab, Ft Belvoir, ATTN: AMSEL-NV-SD
3 USA Computer Sys Cmd, Ft Belvoir, ATTN: Tech Library
1 USAMERDC, Ft Belvoir, ATTN: STSFB-DQ
1 USA Eng Sch, Ft Belvoir, ATTN: Library
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-TD-S
1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATS-CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEX-GS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTS-OR
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-DT
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: DAS/SRD
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEM
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: Library
1 CDR, HQ Ft Huachuca, ATTN: Tech Ref Div
2 CDR, USA Electronic Prvg Grd, ATTN: STEEP-MT-S
1 CDR, Project MASSTER, ATTN: Tech Info Center
1 Hq MASSTER, USATRADOC, LNO
1 Research Institute, HQ MASSTER, Ft Hood
1 USA Recruiting Cmd, Ft Sherdian, ATTN: USARCPM-P
1 Senior Army Adv., USAFAGOD/TAC, Elgin AF Aux Fld No. 9
1 HQ USARPAC, DCSPER, APO SF 96558, ATTN: GPPE-SE
1 Stimson Lib, Academy of Health Sciences, Ft Sam Houston
1 Marine Corps Inst., ATTN: Dean-MCI
1 HQUSMC, Commandant, ATTN: Code MTMT 51
1 HQUSMC, Commandant, ATTN: Code MPI-20
2 USCG Academy, New London, ATTN: Admission
2 USCG Academy, New London, ATTN: Library
1 USCG Training Ctr, NY, ATTN: CO
1 USCG Training Ctr, NY, ATTN: Educ Svc Ofc
1 USCG, Psychol Res Br, DC, ATTN: GP 1/62
1 HQ Mid-Range Br, MC Det, Quantico, ATTN: P&S Div

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1 US Marine Corps Liaision Ofc, AMC, Alexandria, ATTN: AMCGS—F
1 USATRADOC, Ft Monroe, ATTN: ATRO—ED
6 USATRADOC, Ft Monroe, ATTN: ATPR—AD
1 USATRADOC, Ft Monroe, ATTN: ATTS—EA
1 USA Forces Cmd, Ft McPherson, ATTN: Library
2 USA Aviation Test Bd, Ft Rucker, ATTN: STEBG—PO
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Library
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Educ Advisor
1 USA Aviation Sch, Ft Rucker, ATTN: PO Drawer O
1 HQUSA Aviation Sys Cmd, St Louis, ATTN: AMSAV—ZDR
2 USA Aviation Sys Test Act., Edwards AFB, ATTN: SAVTE—T
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA TEM
1 USA Air Mobility Rsch & Dev Lab, Moffett Fld, ATTN: SAVDL—AS
1 USA Aviation Sch, Res Tng Mgt, Ft Rucker, ATTN: ATST—T—RTM
1 USA Aviation Sch, CO, Ft Rucker, ATTN: ATST—D—A
1 HQ, DARCOM, Alexandria, ATTN: AMXCD—TL
1 HQ, DARCOM, Alexandria, ATTN: CDR
1 US Military Academy, West Point, ATTN: Serials Unit
1 US Military Academy, West Point, ATTN: Ofc of Milt Ldrshp
1 US Military Academy, West Point, ATTN: MAOR
1 USA Standardization Gp, UK, FPO NY, ATTN: MASE—GC
1 Ofc of Naval Rsch, Arlington, ATTN: Code 452
3 Ofc of Naval Rsch, Arlington, ATTN: Code 458
1 Ofc of Naval Rsch, Arlington, ATTN: Code 450
1 Ofc of Naval Rsch, Arlington, ATTN: Code 441
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Acous Sch Div
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L51
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L5
1 Chief of NavPers, ATTN: Pers-OR
1 NAVAIRSTA, Norfolk, ATTN: Safety Ctr
1 Nav Oceanographic, DC, ATTN: Code 6251, Charts & Tech
1 Center of Naval Anal, ATTN: Doc Ctr
1 NavAirSysCom, ATTN: AIR—5313C
1 Nav BuMed, ATTN: 713
1 NavHelicopterSubSqua 2, FPO SF 96601
1 AFHRL (FT) William AFB
1 AFHRL (TT) Lowry AFB
1 AFHRL (AS) WPAFB, OH
2 AFHRL (DOJZ) Brooks AFB
1 AFHRL (DOJN) Lackland AFB
1 HQUSAF (INYSD)
1 HQUSAF (DPXXA)
1 AFVTG (RD) Randolph AFB
3 AMRL (HE) WPAFB, OH
2 AF Inst of Tech, WPAFB, OH, ATTN: ENE/SL
1 ATC (XPTD) Randolph AFB
1 USAF AeroMed Lib, Brooks AFB (SUL—4), ATTN: DOC SEC
1 AFOSR (NL), Arlington
1 AF Log Cmd, McClellan AFB, ATTN: ALC/DPCRB
1 Air Force Academy, CO, ATTN: Dept of Bel Scn
5 NavPers & Dev Ctr, San Diego
2 Navy Med Neuropsychiatric Rsch Unit, San Diego
1 Nav Electronic Lab, San Diego, ATTN: Res Lab
1 Nav TrngCen, San Diego, ATTN: Code 9000—Lib
1 NavPostGraSch, Monterey, ATTN: Code 55Aa
1 NavPostGraSch, Monterey, ATTN: Code 2124
1 NavTrngEquipCtr, Orlando, ATTN: Tech Lib
1 US Dept of Labor, DC, ATTN: Manpower Admin
1 US Dept of Justice, DC, ATTN: Drug Enforce Admin
1 Nat Bur of Standards, DC, ATTN: Computer Info Section
1 Nat Clearing House for MH—Info, Rockville
1 Denver Federal Ctr, Lakewood, ATTN: BLM
12 Defense Documentation Center
4 Dir Psych, Army Hq, Russell Ofcs, Canberra
1 Scientific Advsr, Mil Bd, Army Hq, Russell Ofcs, Canberra
1 Mil and Air Attache, Austrian Embassy
1 Centre de Recherche Des Facteurs, Humaine de la Defense
   Nationale, Brussels
2 Canadian Joint Staff Washington
1 C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
3 Chief, Canadian Def Rsch Staff, ATTN: C/CRDS(W)
4 British Def Staff, British Embassy, Washington

1 Def & Civil Inst of Enviro Medicine, Canada
1 AIR CRESS, Kensington, ATTN: Info Sys Br
1 Militaerpsykologisk Tjeneste, Copenhagen
1 Military Attache, French Embassy, ATTN: Doc Sec
1 Medecin Chef, C.E.R.P.A.—Arsenal, Toulon/Naval France
1 Prin Scientific Off, Appl Hum Engr Rsch Div, Ministry
   of Defense, New Delhi
1 Pers Rsch Ofc Library, AKA, Israel Defense Forces
1 Ministeris van Defensie, DOOP/KL Afd Sociaal
   Psychologische Zaken, The Hague, Netherlands

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